



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : G01N 33/02, 33/00	A1	(11) International Publication Number: WO 95/33991 (43) International Publication Date: 14 December 1995 (14.12.95)
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(21) International Application Number: PCT/GB95/01345
(22) International Filing Date: 9 June 1995 (09.06.95)
(30) Priority Data:
9411514.4 9 June 1994 (09.06.94) GB

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(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).

Published

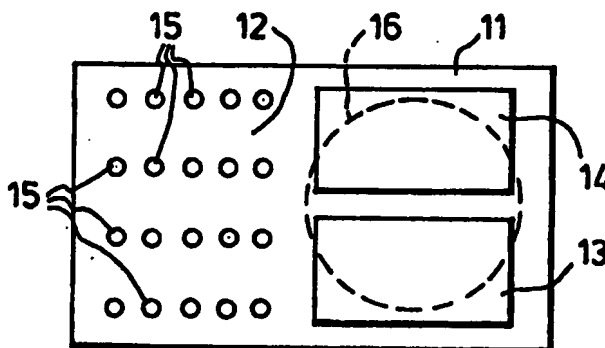
With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: CONDITION INDICATOR

(57) Abstract

There is disclosed a food or other contaminatable or perishable produce condition indicator comprising a tag adapted to be packaged with the produce and comprising sensor means for gas or vapour associated with decay or contamination affecting an electrical property or properties of said sensor means, an electrical circuit measuring said property or properties and an output from said circuit indicating detection of such gas or vapour.



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CONDITION INDICATOR

This invention relates to a food or other contaminatable or perishable produce condition indicator.

Food and other consumable produce usually has a limited life and/or must be kept in prescribed conditions, for example, chilled or frozen. Currently, there is no affordable indicator generally available to indicate the condition of a food item, and reliance is placed on "sell by", "display until" or "best before" labelling. The dates placed on this labelling are usually conservative, and this leads to unnecessary disposal of food which is and will remain for some time in perfect condition.

On the other hand, such labelling does nothing to indicate if food items are contaminated or have perished before the indicated date perhaps through faults in preparation or in storage, for example by accidentally being thawed and refrozen.

The present invention provides a labelling which does not suffer these disadvantages.

The invention comprises a food or other contaminatable or perishable produce condition indicator comprising a tag adapted to be packaged with the produce and comprising sensing means for gas or vapour associated with decay or contamination affecting an electrical property or properties of said sensing means, an electrical circuit measuring said property or properties and an output from said circuit indicating detection of such gas or vapour.

The indicator may be sensitive to gas or vapour associated with bacterial contamination such as, for example, salmonella and/or listerella.

Said sensor means may comprise an array of sensor materials with different electrical responses to particular gases or vapours.

The sensor materials may comprise semi-conducting polymers.

Said output may comprise a connector for an interrogating instrument - said circuit may be at least in part comprised in said instrument. Such an arrangement may be particularly useful in connection with commercial operations such for example as warehousing and supermarkets, where incoming and stored

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goods can be checked by personnel equipped with the instrument, the goods usually in such cases being bulk consignments where, say, a wholesale carton may be checked on arrival or periodically in store.

However, the indicator may be complete in itself, to which end said output may comprise a visual display mounted on the tag, and may be a liquid crystal display. The circuit may be comprised on the tag and may comprise bridge circuit means operative to detect changes in the resistance of groups of sensors selected so that the combined resistance change is sufficient to cause said output to indicate detection of a pre-determined gas or vapour.

The indicator may comprise a wafer-like support on which said sensor means are carried, and said electrical circuit may be printed on said support, which may also carry a battery power source of the kind, perhaps, that is used to power novelty greetings cards, so that the whole device can be made in credit card dimensions. A battery state indicator may be included, which may simply comprise a disappearance of the visual display, it being taken that battery life exceeds shelf-life. As the tag will be examined under illumination of some description, a solar cell could be used as the power source, as, indeed, is done on some credit-card size calculators.

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Since cost is a factor, economies of scale may be had by making one standard indicator device which is sensitive to gases or vapours associated with all the usual bacterial or fungal contaminants and with the decay of the majority of foodstuffs.

Embodiments of condition indicators according to the invention will now be described with reference to the accompanying drawings, in which :

Figure 1 is a diagrammatic illustration of a first embodiment;

Figure 2 is a diagrammatic illustration of a second embodiment;

and Figure 3 is a diagrammatic illustration of a third embodiment.

The drawings illustrate food or other contaminatable or perishable produce condition indicators comprising a tag 11 - of about credit card size - adapted to be packaged with the produce and comprising sensor means 12 for gas or vapour associated with decay or contamination affecting an electrical property or properties of said sensor means 12, an electrical circuit 13 measuring said property or properties and an

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output 14 from said circuit indicating detection of such gas or vapour.

The sensor means 12 can comprise an array of sensor elements 15 of, for example, semiconducting polymer such as polypyrroles which change an electrical property such as resistance or impedance on exposure to gases. An array of different such polymers, included as circuit elements in an electrical circuit, will exhibit a spectrum of responses to different gases or vapours.

Bacteria, such as salmonella and listerella, have associated gases or vapours arising from metabolic processes that affect some of these semiconducting polymers.

Instruments are known in which an array of such sensitive materials responds to different gases or vapours and the response recorded in a library or used to train a neural net so that the instrument can be used to detect such gas or vapour. A typical array might comprise some twenty different materials, and the large number of different combinations of responses enables the identification of large numbers of gases or vapours or mixtures thereof provided the computing power is available.

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In a credit-card size tag, the computing power may be limited, but the number of gases or vapours required to be detected will be relatively small, and it may be sufficient to indicate only that the item monitored is safe or unsafe without identifying the particular cause. Less sophisticated computation is needed, therefore, than in a general purpose instrument.

Instead, therefore, of having each sensor element 15 individually addressable, a group of such, known all to increase in conductivity, for example, on exposure to gases associated with harmful bacteria, can be arranged in a bridge circuit which measures the combined resistance change and, if it is sufficient, it unbalances the bridge circuit to cause the output 14 to indicate detection of such gases, or at least of unknown gases or vapours which are unexpected and which could be harmful.

In the embodiment illustrated in Figure 3, however, there might be no limitation on computing power. The output 14 comprises simply a connector for an interrogating instrument - not shown, but which might be a computer or hand-held device programmed to interpret readings from the sensor elements 15 and which may include at least part of the circuit 13, for example a neural net, which might be configured in hardware or software.

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For a self contained indicator, as illustrated in Figures 1 and 2, however, the output 14 comprises a visual display mounted on the tag, in the form of an lcd panel, and the circuit is also comprised, as by being printed and/or applied using techniques appropriate to the production of semiconductor device such as diodes and transistors.

The sensor elements 15 are deposited in any suitable manner across electrodes printed on the tag, and the embodiment of Figure 1 also has a battery power source 16 of the kind used in novelty greetings cards and which can be contained within the compass of a credit card size device. When such a battery is used it will, of course, have a limited life, and a battery state indicator can be added, which can take the form of a mark on the output display 14. The battery life should exceed the longest safe shelf life of the item in question, absence of a battery state mark indicating that both battery and shelf-life are exhausted.

Figure 2 illustrates an indicator which is powered by a photovoltaic panel 17, which will generate an operating current when the indicator is examined under illumination. If the circuit 13 is hard wired and/or incorporates magnetically stored data, for example in bubble memory, then it will not be necessary for power to be available on a continuous basis.

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CLAIMS

1. A food or other contaminatable or perishable produce condition indicator comprising a tag adapted to be packaged with the produce and comprising sensor means for gas or vapour associated with decay or contamination affecting an electrical property or properties of said sensor means, an electrical circuit measuring said property or properties and an output from said circuit indicating detection of such gas or vapour.
2. An indicator according to claim 1, sensitive to gas or vapour associated with bacterial contamination.
3. An indicator according to claim 2, sensitive to gas or vapour associated with salmonella.
4. An indicator according to claim 2 or claim 3, sensitive to gas or vapour associated with listerella.
5. An indicator according to any one of claims 1 to 4, said sensor means comprising an array of sensor materials with different electrical responses to particular gases or vapours.
6. An indicator according to claim 5, in which the sensor materials comprise semiconducting polymers.

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7. An indicator according to any one of claims 1 to 6, in which said output comprises a connector for an interrogating instrument.
8. An indicator according to claim 7, in which said circuit is at least in part comprised in said instrument.
9. An indicator according to any one of claims 1 to 6, in which said output comprises a visual display mounted on the tag.
10. An indicator according to claim 9, in which said visual display comprises a liquid crystal display.
11. An indicator according to claim 9 or claim 10, in which said circuit is comprised on the tag.
12. An indicator according to claim 10, in which said circuit comprises bridge circuit means operative to detect changes in the resistance of groups of sensors of an array of sensors selected so that the combined resistance change is sufficient to unbalance the bridge circuit means sufficiently to cause said output to indicate detection of a predetermined gas or vapour.
13. An indicator according to any one of claims 1 to 12, comprising a wafer-like support on which said sensor means are carried.

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14. An indicator according to claim 13, in which said electrical circuit is printed on said support.

15. An indicator according to claim 13 or claim 14, said support also carrying a battery power source.

16. An indicator according to claim 15, having a battery state indicator.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 95/01345

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G01N33/02 G01N33/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP,A,0 449 798 (AVL MEDICAL INSTRUMENTS AG) 2 October 1991 see the whole document ---	1,2,5-7
Y	SENSORS AND ACTUATORS. B CHEMICAL, vol. b18, no. 1/3, March 1994 LAUSANNE CH, pages 282-290, XP 000450920 P.-M. SCHWEIZER-BERBERICH, ET AL. 'CHARACTERISATION OF FOOD FRESHNESS WITH SENSOR ARRAYS' see the whole document ---	1,2,5-7
A	WO,A,93 03355 (NEOTRONICS LIMITED) 18 February 1993 see the whole document -----	1,5,6

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

10 October 1995

Date of mailing of the international search report

13.10.95

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 95/01345

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-449798	02-10-91	JP-A- 4215929 US-A- 5407829	06-08-92 18-04-95
WO-A-9303355	18-02-93	CA-A- 2113544 EP-A- 0596973 JP-T- 6509869	18-02-93 18-05-94 02-11-94